couple of your Prime Ministers so that they have to account for all they had done, then I will tell you, yes, you have democracy.'

Does foreign capital support you?

The authority [reputation?] of the Siberian Branch is very high. Our foreign partners support us in creating here international scientific centers. We have one [complete] such center and one unfinished one. We have built a system of survival.

Valentine Afanasievich [Koptyug], what are your proposals for science to our President?

Without education and science, Russia, as with any other country, does not have any future. Now, our scientists are formulating a common-civilized conception of a stable development that is in its essence, socialistic. I have remarked already that Russia was prepared for this concept much better than any other country in the world. We have great resources. We have great industrial and agricultural potentials. [Our] society's mental outlook facilitates the acceptance of the socialistic concept. It should be taken into account that we have advanced much along this socialistic [path], although not without plenty of errors. We must become world leaders of the new way. The main idea of this [new] way is in [producing] a balance [between] economic and social development, and the preservation of the environment.

What are your predictions as a scientist? In the socio-political aspect...

I believe in the re-creation of Russia. And this re-creation will be possible only through the introduction of normal governmental regulation [balanced] with some reasonable elements of the [free] market. But, many elements of the present economical conditions must be reversed. If earlier, the Church was separated from the State, now Science is separated from the State. If earlier, we did not like the way of helping our agricultural state farms, now we do it ourselves (we grow potatoes and cabbages), and spend for this not the two days [as in the past], but much more time.

DENTAL ANALYSIS AND DETERMINATION OF OCCUPATIONAL ACTIVITIES IN A PERUVIAN FORMATIVE POPULATION

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ABSTRACT Dental analysis of the individuals excavated from the Roca Verde Site in southern Peru demonstrated a relationship between dental pathology and sex-related occupational activities in a Formative Period population. Instances of dental attrition, abrasion, and premortem and postmortem fractures were the majority of the dental pathology. The pathological conditions were categorized according to sex. Macroscopic and microscopic investigations of the dentition provided evidence for a sex-related occupational dichotomy.

INTRODUCTION

Sex-related occupational dichotomy in the form of demal usage of the dentition during textile processing can be determined through examination of dental attrition and abrasion and analysis of dental calculus (Nelson, 1997). Samples of male and female teeth, representing the Roca Verde population, were analyzed macroscopically and microscopically to determine a pattern between dental wear, phytolith content of dental calculus, and occupation. The significant differences between male and female attrition and calculus content demonstrate that female dental pathology was mainly caused by textile processing (Figs. 1 and 2).

Roca Verde is a coastal site located in the Atacama Desert of southern Peru. Based upon archaeological evidence, the Formative Period (ca. 1000 BC) is the approximate date for the site (Burger, 1988; Moseley, 1992). Excavation of the Roca Verde site produced roughly 130 features[1] of human skeletal remains that could be used for analyzing the frequency of skeletal pathology. Most of the features were adults aged 20-30 years, although the remains also included infants, juveniles, and older adults.

The skeletal and dental examinations revealed frequent dental attrition and abrasion, postcranial osteoarthritis, and some instances of skeletal fractures. This report focuses only upon the frequency and severity of dental attrition and abrasion within the Roca Verde population.

MATERIALS AND METHODS

For the macroscopic analysis, a total of 418 teeth from the Roca Verde collection were analyzed on location in Peru. Tooth sockets for missing teeth were also examined to determine whether the tooth had been lost premortem, postmortem, or due to an abscess. Many of the features from the site contained fragmentary remains that could not be sexed or aged. A sub-sample of 14 features became the primary focus of the analysis.

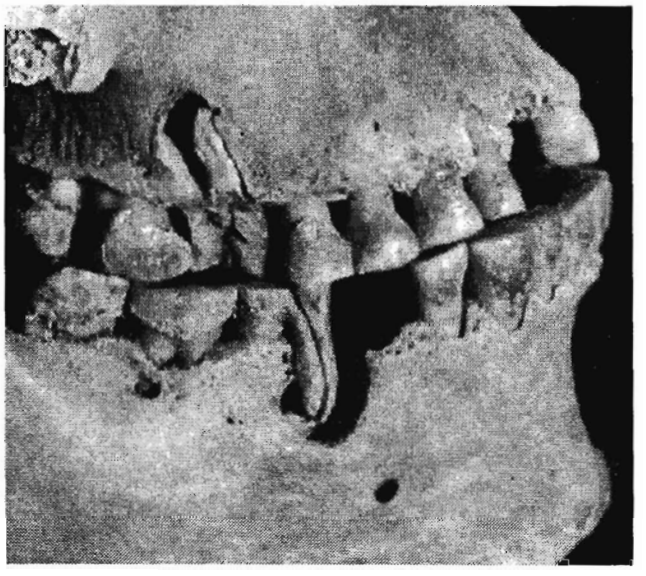

Fig. 1. Feature E 23, right side. The mandibular first molar demonstrates a premortem fracture running longitudinally from the occlusal surface of the crown to the apex of the roots.

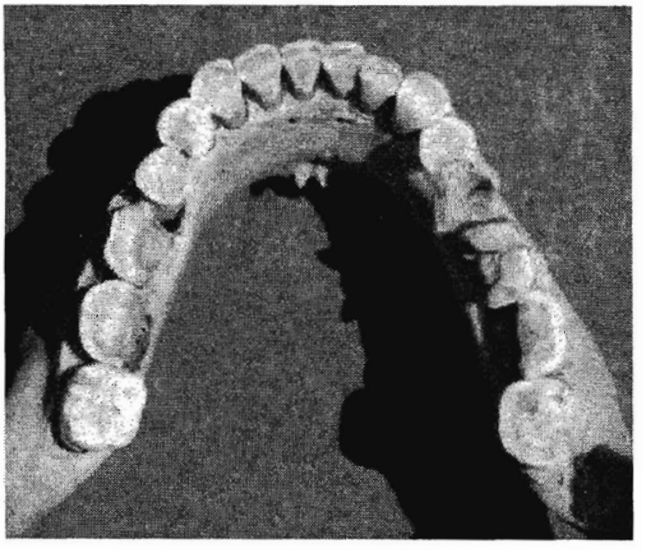

Fig. 2. Feature E 23, occlusal view of the mandibular dentition. The right first molar has polishing of the exposed dentin, indicating that the tooth was continually used until death.

The 14 features were chosen based upon the completeness of both the skeletal remains and the dentition. Seven female features and seven male features were included in the study. The mean age for the female features was 27.0 years old and the mean age for the male features was 27.2 years old. Sex determination was based upon characteristics of the innominate, clavicle, mandible, and the robusticity of the long bones. Age determination was based upon the methods of Brooks and Suchey (1990) for aging the pubic symphysis and Szilvassy (Steele and Bramblett, 1988) for aging the clavicle.

Nelson and Dr. Karl J. Reinhard, University of Nebraska-Lincoln, developed a scoring method applicable to the attrition and abrasion in the dentition found in the Roca Verde features. For each type of tooth, scores were recorded for no wear, mild wear, moderate wear, severe wear, dental abscess, premortem loss, and postmortem loss.

The dental attrition and abrasion of the sample was scored with the following methodology. For the incisors and canines: no wear = no wear; mild wear = polishing (smooth and bright surface due to rubbing) of the enamel to polishing of the enamel with a thin line or one small exposure of dentin; moderate wear = wide line or large area of dentin exposed; severe wear = only a rim or partial rim of enamel around dentin. For the premolars: no wear = no wear; mild wear = polishing of the enamel to polishing of the enamel with an exposure of one point of dentin; moderate wear = exposed dentin; severe wear = no enamel on occlusal surface and a rim or a partial rim of enamel exhibited on the margin of the tooth. For the molars: no wear = no wear; mild wear = polishing of the enamel to polishing of the enamel with exposure of one to four points of

dentin; moderate wear = most occlusal enamel worn away with large areas of dentin exposed; severe wear = all occlusal enamel worn away except for a rim or partial rim of enamel surrounding dentin.

For the statistical investigation, the chi-square analysis was used. The purpose was to show the presence of significant differences between the frequencies of the variables.

The microscopic analysis was done using the Scanning Electron Microscope (SEM) on a different sample of teeth from the Roca Verde population after the macroscopic analysis was completed. The intention of the analysis was to determine any significant difference between male and female microscopic dental features, and whether the difference corresponded with the results of the macroscopic analysis. Since the teeth have been shown to be important in processing solid vegetal material (Nelson, 1997), the occlusal surface should reflect the activity.

A number of loose teeth from the laboratory at Centro Mallqui in Peru were analyzed at the University of Nebraska. In total, 23 teeth from the Roca Verde Site collection were used for SEM analysis. Three female features (fourteen total teeth), one male feature (four total teeth), and two unidentified features (five total teeth) represented the sample.

Parallel striations were apparent on the occlusal surface of all the teeth used in the SEM analysis. To determine if there was a difference between the number of striations on the female and male teeth, SEM micrographs were taken of every tooth. The first micrograph was taken at a magnification between 1000X and 1500X. The second micrograph was taken in approximately the same region as the first micrograph, but at a magnification between 4000X and 5000X. The most precise working distance, 10mm, was consistent for each micrograph.

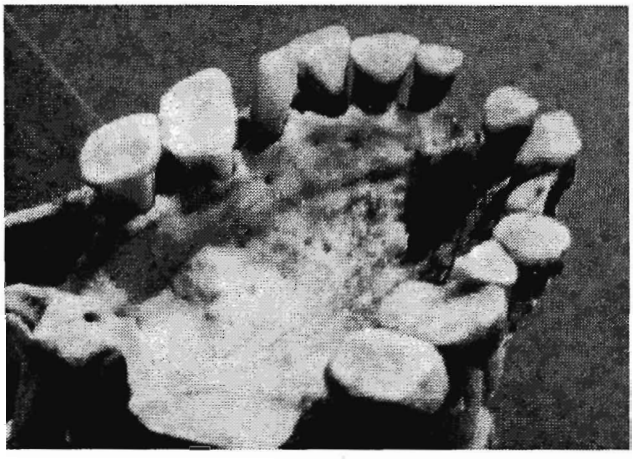

Fig. 3. Feature E 21-1, occlusal view of the maxillary dentition. The dental attrition and abrasion is typical for the females in the population. The severity of the dental attrition is the result of textile processing.

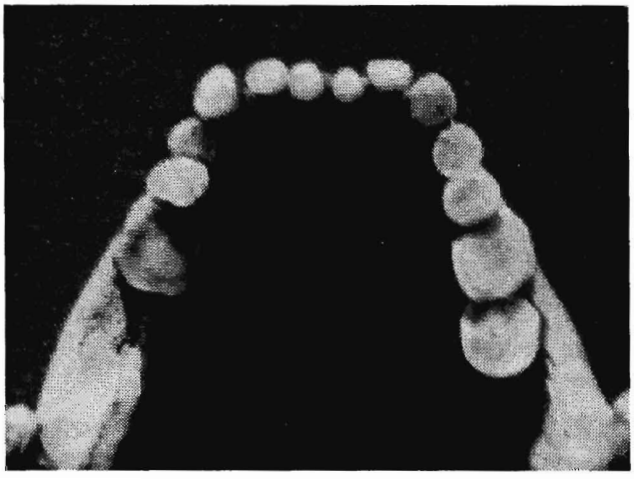

Fig. Fig. 4. Feature E21-1, occlusal view of the mandibular dentition.

Incisors, canines, and premolars were evaluated with SEM techniques. Micrographs were taken on the labial mesial surface of the incisal edge. The occlusal surfaces of canines and premolars were first scanned for the presence of striations. Then the micrographs were taken at the location of the recognizable striations. Molars were not included in the sample for microanalysis, due to the severity of wear and the exposure of dentin.

Dental calculus was removed from the teeth of five of the features. A sample of totora[2] matting made from species in the genus *Scirpus* (Reinhard, 1997) was taken for the extraction of phytoliths. The samples were dissolved and the macroscopic components were examined by light microscopy and SEM. A detailed description of this analysis will be included in a future publication by Reinhard and Nelson.

RESULTS

According to the macroscopic analysis, a large difference existed between female and male attrition and abrasion. Female features, in general, showed a greater frequency and severity of dental attrition and abrasion than did

the male features (Figs. 3 to 6). The variations between males and females in overall dental pathology, mainly attrition and abrasion, were statistically different (χ^2=53.12, p<0.001). A meaningful difference between males and females was seen in the first and second premolars (χ^2=9.82, 0.005>p>0.001) and in the lateral and central incisors (χ^2=6.53, 0.025>p>0.01). The statistical difference was also significant in the first and second molars (χ^2=9.29, 0.005>p>0.001). The chi square values for the canine teeth (χ^2=2.85, 0.10>p>0.05) were not significant.

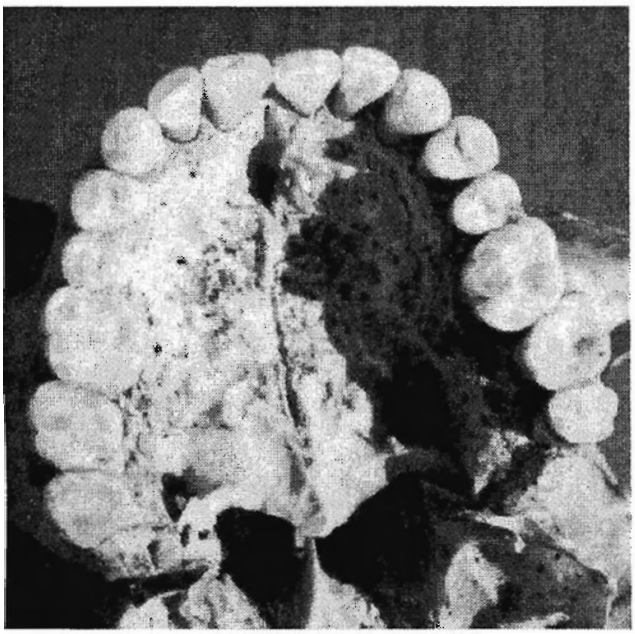

Fig. 5. Feature E 21-2, occlusal view of the maxillary dentition. The typical case of male frequency of dental attrition and abrasion is demonstrated by E 21-2, a male in his early to mid-twenties. Although some small areas of dentin may be exposed through the enamel, the frequency and severity of dental attrition and abrasion are much less than those in the females in the population. Features E 21-1 and E 21-2 were associated in the same burial.

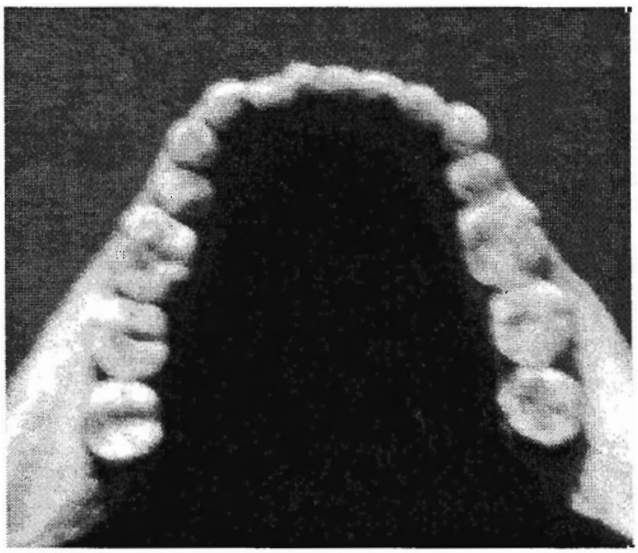

Fig. 6. Feature E 21-2. Occlusal view of the mandibular dentition.

Microscopic results were less significant than the macroscopic results in demonstrating a dichotomy between male and female dental pathology. Microscopic analysis revealed a number of attrition-based striations visible on the surface of most teeth. Quantitative differences of striations were not significant between male and female features.

Examination of the dental calculus from all of the females revealed fibers and phytoliths consistent with the types present in the textiles. Fragmented cotton fibers dominated in three female samples, indicating the use of teeth to prepare cotton, probably for weaving. Silica phytoliths consistent with totora, squash, and beans were also found. Manioc and maize starch grains were both present in male and female dental calculus. A variety of phytolith shapes, which could not be identified taxonomically, were also found.

DISCUSSION

The macroscopic analysis demonstrated significant differences between male and female dental attrition and abrasion. The variations between male and female overall dental pathology were statistically significant for the incisors, premolars, first molars, and second molars. The canines were the only teeth that failed to demonstrate a statistical difference for cases of male and female dental attrition and abrasion. Also, every female mandibular tooth in the analysis exhibited dental pathology.

Microscopic analysis (SEM) indicated striations on almost every tooth in the sample regardless of sex. Due to severe attrition and exposure of dentin, striations may have naturally eroded away on some teeth, especially the severely worn female teeth, leading to an inaccurate determination of the number of

striations present. Further testing of the actual surface of the tooth may reveal the chemical components still present on the tooth at the time of death, which possibly could have led to the surface reduction of the tooth.

The presence of phytoliths and fibers in the dental calculus, which are consistent with those in the textiles, suggest that dental wear was caused by textile processing. However, the dental calculus analysis showed that totora was not the only phytolith source of dental abrasives. Along with vegetal fibers from wood and cane, the calculus also contained grit and maize, bean, and squash phytoliths.

The frequency of female dental attrition and abrasion was most likely the result of basket and textile processing. The female wear appears to be too severe to have been caused strictly by diet. Moreover, analysis of the dental calculus exhibited dietary phytoliths on both male and female teeth. However, cotton fibers, cane, and totora phytoliths were demonstrated mainly on female teeth. The macroscopic, microscopic, and phytolith evidence suggests that the excessive attrition and abrasion of the female teeth in comparison with these conditions in the male teeth was likely caused by the processing of vegetal remains related to textile production.

CONCLUSION

The differences in dental attrition and abrasion between male and female features can be attributed to sex-related occupational dichotomy. Analysis of dental calculus from samples of Roca Verde teeth revealed phytoliths from totora, cotton fibers, and other vegetal material. Maize, Cucurbit, and bean phytoliths were also discovered in the dental calculus. Most likely, the totora and vegetal fibers from wood and cane used to make baskets and textiles (True, 1980) caused the severe attrition and abrasion of the female teeth. The severe dental pathology, along with the collaborating evidence of the presence of textile phytoliths in the dental calculus supports the hypothesis that textile processing was a major task for the females of the Roca Verde population.

[1]A feature is one skeleton.
[2]Totora is a phytolith-rich plant from a species in the genus *Scirpus*.

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ACKNOWLEDGMENTS

I would like to thank Dra. Sonia Guillen and Drs. Karl J. Reinhard, Matthias I. Okoye, Doug Scott, and Dan Tylka for their scientific support and guidance. I would also like to thank Lisa A. Fitzpatrick and Kate Blue for their editorial comments. The University of Nebraska and Karl J. Reinhard funded my research. Dra. Sonia Guillen, Dr. Jane Buikstra, Dr. Roxie Walker, and other workers involved with the Centro Mallqui kindly permitted my access to the laboratory and to the Roca Verde population.